Claims

We claim:

1. A method for removing a patch comprising an oxide of titanium from a layer comprising cobalt disilicide, comprising the step of:

removing the patch by applying a reagent to the patch at a predetermined temperature and for a predetermined time, wherein the reagent does not chemically react with the layer, and wherein the reagent comprises water, ammonium hydroxide, and hydrogen peroxide.

2. The method of claim 1, wherein for the removing step:

the ammonium hydroxide comprises approximately 4 percent of a total reagent volume of the reagent,

the hydrogen peroxide comprises approximately 4 percent of the total reagent volume,

the predetermined temperature is approximately between 45 degrees celsius and 95 degrees celsius, and

the predetermined time is approximately between 30 seconds and 10 minutes.

3. A method for forming an electrical structure comprising a layer of cobalt disilicide, comprising the steps of:

providing a substrate comprising a layer of silicon;

forming a layer of cobalt on the layer of silicon;

forming a layer of titanium nitride on the layer of cobalt;

executing a first annealing of the substrate to react the layer of cobalt with an upper portion of the layer of silicon to form a layer of silicides of cobalt between the layer of titanium nitride and a remaining layer of silicon, and wherein the layer of silicides comprises cobalt silicide and cobalt disilicide;

conducting a first cleaning of the substrate to remove the layer of titanium nitride, wherein an impurity is left on the layer of silicides of cobalt;

conducting a second cleaning of the substrate to remove the impurity;

performing a second annealing of the substrate at an annealing temperature, and for an annealing time, sufficient to transform the layer of silicides of cobalt into the layer of cobalt disilicide, wherein a stringer comprising an oxide of titanium is left on the layer of cobalt disilicide; and

conducting a third cleaning of the substrate to remove the stringer by applying a reagent to the substrate at a predetermined temperature and for a predetermined time, wherein the reagent does not chemically react with the layer of cobalt disilicide, and wherein the reagent comprises water, ammonium hydroxide, and hydrogen peroxide.

4. The method of claim 3, wherein for the step of conducting a third cleaning:

the ammonium hydroxide comprises approximately 4 percent of a total volume of the reagent,

the hydrogen peroxide comprises approximately 4 percent of the total volume of the reagent,

the predetermined temperature is approximately between 45 degrees celsius and 95 degrees celsius, and

the predetermined time is approximately between 30 seconds and 10 minutes.

5. The method of claim 3, wherein the substrate in the providing step comprises a film of silicon dioxide on the layer of silicon, and wherein a step of removing the film of silicon dioxide is performed prior to the step of providing a substrate.

6. The method of claim 3, wherein the step of conducting a first cleaning of the substrate comprises immersing the substrate in a mixture of hydrogen peroxide and sulfuric acid.

7. The method of claim 3, wherein the impurity in the step of conducting a first cleaning is from the group consisting of a titanium compound, a cobalt compound, and a silicon compound.

8. The method of claim 3, wherein the step of conducting a second cleaning of the substrate comprises the steps of:

applying a first reagent to the substrate at a temperature of approximately 40 degrees celsius, wherein the first reagent comprises water, ammonium hydroxide, and hydrogen peroxide, wherein the ammonium hydroxide comprises approximately 4 percent of a total volume of the first reagent, and wherein the hydrogen peroxide comprises approximately 4 percent of the total volume of the first reagent; and

applying a second reagent to the substrate at a temperature of approximately 65 degrees celsius, wherein the second reagent comprises water, hydrochloric acid, and hydrogen peroxide, wherein the hydrochloric acid comprises approximately 5 percent of a total volume of the second reagent, and wherein the hydrogen peroxide comprises approximately 4 percent of the total volume of the second reagent.

9. A method for forming cobalt disilicide within an FET, wherein the FET is an insulated-gate field effect transistor, comprising the steps of:

providing a substrate comprising the FET, a left insulating structure bordering a left side of the FET, a right insulating structure bordering a right side of the FET, and a top surface, wherein the FET comprises a source, a drain, and a gate, and wherein the top surface comprises a top surface of the FET, a top surface of the left insulating structure, and a top surface of the right insulating structure;

forming a layer of cobalt on the top surface;

forming a layer of titanium nitride on the layer of cobalt;

performing a first annealing of the substrate to react a portion of the layer of cobalt with the source, the gate, and the drain, wherein a top portion of the source is converted into a first silicide region comprising cobalt silicide and cobalt disilicide, wherein a top portion of the gate is converted into a second silicide region comprising cobalt silicide and cobalt disilicide, wherein a top portion of the drain is converted into a third silicide region comprising cobalt silicide and cobalt disilicide, and wherein unreacted cobalt remains;

conducting a first cleaning of the substrate to remove the layer of titanium nitride and the unreacted cobalt, wherein an impurity is left on the FET;

conducting a second cleaning of the substrate to remove the impurity;

performing a second annealing of the substrate at an annealing temperature and for an annealing time sufficient to effectuate a cobalt silicide to cobalt disilicide reaction within a silicide zone, wherein the silicide zone comprises the first silicide region, the second silicide region, and the third silicide region, and wherein a stringer comprising an oxide of titanium

contacts the silicide zone; and

conducting a third cleaning of the substrate to remove the stringer by applying a reagent to the substrate at a predetermined temperature and for a predetermined time, wherein the reagent does not chemically react with the cobalt disilicide zone, and wherein the reagent comprises water, ammonium hydroxide, and hydrogen peroxide.

10. The method of claim 9, wherein for the step of conducting a third cleaning:

the ammonium hydroxide comprises approximately 4 percent of a total volume of the reagent,

the hydrogen peroxide comprises approximately 4 percent of the total volume of the reagent,

the predetermined temperature is approximately between 45 degrees celsius and 95 degrees celsius, and

the predetermined time is approximately between 30 seconds and 10 minute.

11. The method of claim 9, wherein the substrate in the providing step comprises a film of silicon dioxide on a portion of the top surface, and wherein a step of removing the film of silicon dioxide is performed prior to the step providing a substrate.

12. The method of claim 9, wherein the substrate in the providing step comprises a buried oxide layer, wherein the step of forming a layer of cobalt results in the FET being positioned between the buried oxide layer and the layer of cobalt.

13. The method of claim 9, wherein the step of conducting a first cleaning of the substrate comprises immersing the substrate in a mixture of hydrogen peroxide and sulfuric acid.

14. The method of claim 9, wherein the impurity in the step of conducting a first cleaning is from the group consisting of a titanium compound, a cobalt compound, and a silicon compound.

15. The method of claim 9, wherein the step of conducting a second cleaning of the substrate comprises the steps of:

applying a first reagent to the substrate at a first temperature of approximately 40 degrees celsius, wherein the first reagent comprises water, ammonium hydroxide, and hydrogen peroxide, wherein the ammonium hydroxide comprises approximately 4 percent of a total volume of the first reagent, and wherein the hydrogen peroxide comprises approximately 4 percent of the total volume of the first reagent; and

applying a second reagent to the substrate at a second temperature of approximately 65 degrees celsius, wherein the second reagent comprises water, hydrochloric acid, and hydrogen peroxide, wherein the hydrochloric acid comprises approximately 5 percent of a total volume of the second reagent, and wherein the hydrogen peroxide comprises approximately 4 percent of the total volume of the second reagent.

16. The method of claim 9, wherein the left insulating structure in the providing step comprises a trench isolation structure.

17. The method of claim 9, wherein the left insulating structure in the providing step comprises a grown oxide of silicon.

18. The method of claim 9, wherein a left insulating spacer borders a left side of the gate and a portion of a top side of the source, and wherein a right insulating spacer borders a right side of the gate and a portion of a top side of the drain.

19. The method of claim 9, wherein the step of forming a layer of cobalt is accomplished by a first sputtering process comprising:

placing the substrate into a depressurized chamber, wherein the chamber comprises argon gas and a region of cobalt;

energizing the argon gas to form and accelerate argon ions, wherein a percentage of the accelerated argon ions strikes the region of cobalt to generate moving cobalt particles, and wherein a share of the moving cobalt particles adheres to the layer of silicon to form the layer of cobalt.

20. The method of claim 9, wherein the step of forming a layer of titanium nitride is accomplished by a second sputtering process comprising:

placing the substrate into a depressurized chamber, wherein the chamber comprises argon gas, nitrogen gas, and a region of titanium;

energizing the argon gas to form and accelerate argon ions, wherein a percentage of the accelerated argon ions strikes the region of titanium to generate moving titanium particles, and wherein a portion of the moving titanium particles strikes and combines with the nitrogen gas to form titanium nitride particles, and wherein a share of the titanium nitride particles contacts the layer of cobalt to form the layer of titanium nitride.

21. The method of claim 9, wherein the step of performing the first annealing is executed at a first annealing temperature of approximately 575 degrees celsius for a first annealing time of approximately 80 seconds.

22. The method of claim 9, wherein the step of performing the second annealing is executed at the annealing temperature of approximately 750 degrees celsius for the annealing time of approximately 30 seconds.

23. The method of claim 9, wherein the source and the drain in the providing step each comprise N-doped silicon.

24. The method of claim 9, wherein the source and the drain in the providing step each comprise P-doped silicon.

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